An Academic Home Run:
Baseball, Umpiring and Mathematics

Robert D. Homolka
Professor of Mathematics, Kansas State University at Salina

Abstract

America's most popular past-time of baseball can be applied to mathematics by teachers by weaving real life examples, stories, and history into mathematics classes to create a learning environment for today's students that makes the   educational experience memorable and enjoyable. Mathematical word problems and stories are two common approaches used by teachers that are explained in this paper.

Mathematics, Academics, and Baseball

the umpire with raised arms!
a trail of dust still circling
the infield[1]

Haiku, Japanese poetry, captures in poetic form the moments in every baseball game that make fans catch their breath and pause while the pitcher looks for a sign, the moment a rookie gets picked off first, or the instant the batter lashes a homer into the night sky, just before the crowd explodes onto its feet.[2] Mathematics as well captures the essence of the game in statistics and numbers in a way that can cause students to jump to their feet in excitement about a subject otherwise often thought as dreary, tough, or unimportant.

Many situations that take place on a baseball field can easily be carried over and analyzed in an academic environment in search of fun, interesting academic goals. Not only is baseball useful in helping students learn mathematic problems, but baseball history also provides a comparison of different eras of the game along with the different statistics of each period. Higher order thinking problems can be derived from the history of the game.[3]

When one thinks of mathematics, the sport of baseball is increasingly used by mathematics teachers who want to decrease emphasis on routine procedural skills and increase emphasis on real-world uses of mathematics and multi-step problem solving.[4]   The combination of the terms "baseball" and "mathematics" is so popular that over 31,000 Google sites reference the words "together. There are many reasons why these subjects are often combined. This paper discusses these reasons and explains benefits students can derive from numerous types of mathematics problems. Finally, two examples are included which the author uses in teaching to bring life to mathematics through real life baseball stories, examples and problems.

The Relationship of Baseball and Mathematics

college ballpark
fungoes one after another
into the blue sky[5]

One reason baseball is used in mathematics is because it gives mathematics teachers a way to "find a way to train students to recognize mathematics problems in an everyday situation. This training will allow students to transfer acquired knowledge to the academic environment and approach the solution of the problem from different points of view."[6] The game of baseball contains an amazing source of statistics, stories, history, and game situations that give mathematics teachers the opportunity to showcase mathematics problems to students in ways that can make the mathematics educational experience memorable and enjoyable.

Mathematics problems can analyze times, distances, speed for running, throwing and hitting. Ken Burns in his PBS documentary on baseball included a segment from Bob Costas which summed up the mental game[7]:

> "….and this is one of the great things about baseball, where you calculate so many things simultaneously. A ball is hit into the gap…how good is the fielders' arms? …where is the cut-off man? …A quick look and a glance…the runner is between first and second…how fast is that runner? …how many outs? …should he try for third?...Is his history that he is daring? …will he tray for third?...what is the third base coach doing?... Any you take all of these things with depth perception…you try to calculate fleeting seconds…What are the possibilities?

Baseball can also assist students in the understanding of spatial reasoning, probabilities, and statistics by giving assignments that ask students collect and record data, determine possible outcomes or combinations of a situation, and create and interpret graphs.

Another reason for the affiliation between baseball and mathematics is due to the relationship between college mathematics faculty and baseball which goes back several years and continues today.

Ernest Quigley, a National League veteran umpire of 22 years lived in Concordia, Kansas, owned a hog ranch in Kansas and taught mathematics at St. Mary's College in Kansas[8]. Quigley officiated over 5400 major league baseball games including six World Series. He also officiated 40 football games including Rose Bowl, Cotton Bowl and five Harvard-Yale games.[9] Quigley Field, the University of Kansas' first baseball stadium was named after him.[10]

Today, Oklahoma math professor Chris Oehrein calls between 50 and 55 games per season as an umpire. Oehrein's career started at the request of his department head when he taught at the University of Marshall in West Virginia[11].

Finally, the author, a mathematics professor, has umpired collegiate baseball for over 30 years including a stint in the Major Leagues and umpiring the Collegiate World Series twice.

Using Baseball Problems In Mathematics Classes

Home run trot--
the batter's eye a tape
measuring the distance[12]

One strategy illustrated to show how outfielders catch a fly ball is the linear optical trajectory (LOT) model which received national attention in 1995. This model uses equations to relate the motion of the fly ball to the motion of the outfielder using a mathematical foundation. The LOT hypothesis determines the strategy the fielder uses to catch a fly ball by following a path that will keep the optical trajectory projection angle constant, this is equivalent to keeping the ration (tan cx)/(tan B) constant.[13]

Carol Rodino, a New Jersey mathematics instructor and author of the book *Fantasy Baseball and Mathematics: A Resource Guide for Teachers, Parents* contains hundreds of math formulas that cover algebra, measurement, data analysis, probability and problem solving to calculate the number of points and the team with the most wins.[14]

Mathematician Michael J. Bradley, Merrimack College in North Andover, Mass spent time studying the geometry dimensions in baseball including the five sided home base and the baseball "diamond" which is a square, 30 yards on each side all which offer opportunities for student discovery.[15]

Then there is Barry Bonds' record breaking home run of Hank Aaron's record for career home runs when he hit his 756th home run August 7, 2007. Mathematicians everywhere scrambled to use the event in class room studies by following the trajectory of the fly ball which can be calculated given the initial conditions (location, velocity, and spin) and a model for the forces acting on the ball. These forces include gravity, air resistance, and the Magnus force on a spinning baseball.[16]

Even the leather or vinyl cover of the baseball itself which consists of two identical pieces, stitched together, then stretched to cover cork, rubber, or yam-wound core of the ball is a design piece that, from a mathematical viewpoint, can be thought of as a simple closed curve on the surface of a sphere. The curve serves as a boundary between two congruent identical regions which can be an interesting study for mathematics students.[17]

The Society for American Baseball Research (http://www.sabr.org/), established in Cooperstown, New York in 1971, offers multiple resources for teachers on the long tradition of detailed records on a variety of offensive and defensive aspects of the sport. Online resources include a classified section to assist researchers, links to other baseball resources and over 200,000 documents indexed by subject, title, or persons referenced. Local chapters are in Des Moines (http://chapters.sabr.org/fieldofdreams/) and Kansas City (http://sports.groups.yahoo.com/group/SABRmonarchs/) .

Storytelling and Teaching Mathematics

Hopping over the mound
and into the dougout --
the first robin[18]

Storytelling was once thought to be mostly for children, or for library programs, but it is now being applied widely in the business and corporate world by management and human relations

departments for employee training, knowledge transfer, and cultural change and in academic settings by faculty as a pedagogical tool for effective teaching. One reason storytelling is making a comeback is because of the estimated 60 million to 74 million millennial generation students and employees born from around 1977 to 1995 who are flooding colleges and entering the workplace with learning styles favorable to storytelling. Another reason is the value of stories in a learning setting.[19]

"Our generation isn't all about sex, drugs, and violence. It's about technology, discovery, and coming together as a nation." Mikah Giffin, eonline, 2000 Millennials. Storytelling creates a "coming together" of those participating. Millennial students, today's generation, have a commitment to arts, leadership, interactivity, service, and they respond to authority and entertainment.[20]

A 2002 Harris Poll goes further to indicate why baseball stories are important in teaching mathematics because the poll listed the top five groups that influence today's generation of students:[21]

- 59% -- my mother
- 43% -- my father
- 22% -- my grandparent
- **19% -- a teacher or coach**
- **18% -- an entertainer**

The Harris poll shows that students respect authority figures such as teachers and coaches. These characteristics create an opportunity for teachers to use true and entertaining baseball stories to enhance learning in mathematics classes.

Michael Schiro and Doris Lawson's book *Oral Storytelling & Teaching Mathematics* contains two case studies of teachers telling epic oral stories to teach math. Their book is "largely about how mathematics and oral storytelling can be woven together to provide an exciting method of teaching mathematics. Oral storytelling transforms the abstract, objective, deductive mathematics we have all experienced in school into a subject surrounded by imagination, myth, and subjective meanings and feelings." [22]

Two Mathematics Presentations Using Baseball Stories

August heat
umpire and manager
nose to nose[23]

There are numerous approaches to incorporating baseball into mathematics. Besides the approach of developing classroom problems, another approach is to use stories as part of a class room presentation or external presentations. Two presentations the author uses frequently involve telling stories about umpiring and telling stories about Yogi Berra's "Yogism's" that relate to mathematics and problem solving skills. For example when telling the Yogism "It ain't over till its over" I share with students how they use mathematics all their lives and I try to have contact with them outside of class. Or the Yogism" We make too many wrong mistakes" relates

to mathematics because students do many things intuitively that are wrong rather than make decisions based on facts.

Each Yogism is different. I relate the situation in teaching where it applies. Yogi said "There are some people who if they don't know already know you can tell them". This applies in mathematics because students sometimes say "Leave me alone. I'll do it my way. This is how I learned it in high school." Here are two examples of two different slide presentations used:

Presentation #1: *Baseball and Mathematics: Yogi Berra's Guide to Teaching Mathematics (Three sample presentation slides):*

Slide One: Bob's Drawers

- What you know is what you know.
- Do mathematically, anything you want, making sure what you do—you do right.
- You do not know very much

Slide Two   Yogi- Educator

- Quoted more than most poets
- "Never answers anonymous letters"
- "I am not buying my kids encyclopedias! Let them walk like I did."

Slide Three   "I wish I had an answer to that because I'm tired of answering that question"

- Why can't you divide by zero?
- Why does a circle have 360 degrees?
- Why is :m: used for a slope
- Why is x ^0 equal to 1?
- Why Ln x and not nL x?
- Why isn't 1 a prime number?
- WWII manual 1 was! When did it change? Why?
- Today I celebrated my 100th error! Zipper

Presentation #2: *If You Open a Hunting Season on Umpires- I Would be Safe! (Three sample presentation slides):*

Slide One   History of Umpiring

- Villains by fans
- Adversarial autocrats by players
- Invisible men by press
- Submerged like idiot children in a family album
- October 6, 1945 (Attorney Wm. Wheaton- 1st game)

- 1845-1858: Used two umpires and a neutral ref.

Slide Two   1903- Ban Johnson AL

- Strong Support for Umpires
- 2 Umpire system
- Cy Rigler – raising right hand on strikes
- Actually (for Dummy Hoy) (had to read lips and pitchers took advantage)
- Lord Byron- singing umpire
- Bill Klem- greatest ump of all time "never missed one in my life"
- Bob Emslie- (Wore wigs. Nerves caused baldness)

Slide Three   Bob's Stories

- OSU Foul Homerun
- Last year OSU Frank yelled at every pitch
- Two things I do not like. Long games and making decisions.
- Ed Moriarty. How do you spell our name? As I expected! One "I"

Summary

entering
the batter's box
afternoon shadows[24]

Since mathematics and baseball are both the vocation and avocation of many college mathematics professors combining the two topics and using oral stories and mathematics word problems can enhance any mathematics learning environment.

As one who has been doing this for over three decades, I highly recommend developing this approach as part of a teacher's pedagogical toolbox.

Bibliography

[1]Heuvel, Cor van den, Tamura, Namae. Baseball Haiku W. W. Norton & Company. p 34

[2] Ibid

[3] Thompson, Denise R, University of South Florida, Senk, Sharon I. Michigan state University. The Effects of Curriculum on Achievement in Second-Year Algebra: The example of the University of Chicago School Mathematics Project.

[4] Ibid

[5] Heuvel, Cor van den, Tamura, Namae. Baseball Haiku W. W. Norton & Company. p 31

[6] Prieto, Joseph. Take Me Out to the Ball Game…Memorial Elementary. Downloaded July 10, 2009.
http://hti.math.uh.edu/curriculum/units/2008/04/08.04.04.pdf

[7]Ken Burns on PBS. Baseball. A Film By Ken Burns. For Teachers. Shadow Ball. Downloaded July 10, 2009.
http://www.pbs.org/kenburns/baseball/teachers/lesson1.html

[8] Time Magazine. Sport: Stark Despair. February 10, 1936. time Partners with CNN. Downloaded July 12, 2009. http://www.time.com/time/magazine/article/0,9171,755808,00.html

[9] Kansas Historical Society. E. C. (Ernie) Quigley. Vertical File Biographies. Downloaded July 10, 2009.
http://www.kshs.org/genealogists/individuals/vertical/bios/quigleyerniec.htm

[10] Wikipedia. Ernie Quigley. Downloaded July 12, 2009. http://en.wikipedia.org/wiki/Ernie_Quigley

[11] Pioneer Online. Oklahoma City Community College. Life-long Passion for baseball puts OCCC Professor Behind the Plate. Downloaded July 10, 2009.
http://www.occc.edu/Pioneer/Archives/April_20_2009/features1.html

[12]Heuvel, Cor van den, Tamura, Namae. Baseball Haiku W. W. Norton & Company. p 7

[13] Aboufadel, Edward. **A Mathematician Catches a Baseball** , *The American Mathematical Monthly*, Vol. 103, No. 10 (Dec., 1996), pp. 870-878, Mathematical Association of America. Kansas state University at Salina. July 10, 2009. www.jstor.org/stable/2974611

[14] "Hey, batter, batter: Grades 5-12.(Math Matters)(Brief article)." Curriculum Review 47.3 (Nov 2007): 7(1). Academic OneFile. Gale. Kansas State University - Salina. 13 July 2009
<http://find.galegroup.com/itx/start.do?prodId=AONE>.

[15] MAA Online. The Mathematical Association of America. Ivars Pererson's MathTrek. Pythagoras Plays Ball
Downloaded July 12, 2009. http://www.maa.org/mathland/mathland_3_25.html

[16] Nathan, Alan. Analysis of Barry Bonds' Record Breaking Home Run. Department of Physics. University of Illinois. Downloaded July 10, 2009. http://webusers.npl.illinois.edu/~a-nathan/pob/bonds/b756.html

[17] MAA Online. The Mathematical Association of America. Ivars Pererson's MathTrek. Curves on baseballs
Downloaded July 12, 2009. http://www.maa.org/mathland/mathtrek_4_13_98.html

[18] Heuvel, Cor van den, Tamura, Namae. Baseball Haiku W. W. Norton & Company. p41

[19] Stephens, Greg. Using Storytelling to Meet the Technology and Information Literacy Needs of Millennial Students. Professional Day, Kansas State University at Salina. January 2009

[20] Horne, Pam. Understanding the Millennial Generation. Michigan State University, 2006. Downloaded November 26, 2008.
http://www.tap.msu.edu/PPT/2006/Understanding%20the%20Millennial%20Generation%202006.ppt

[21] Ibid

[22] Schiro, Michael, Lawson, Doris. Oral Storytelling and Mathematics. Sage Publications. Boston College. 2004

[23] Heuvel, Cor van den, Tamura, Namae. Baseball Haiku W. W. Norton & Company. p 57

[24] Heuvel, Cor van den, Tamura, Namae. Baseball Haiku W. W. Norton & Company. p 129

Biographical Information

ROBERT D. HOMOLKA

Robert is on the faculty at K-State in Salina where he teaches Mathematics classes in the Arts, Sciences and Business department. Besides teaching, he has umpired collegiate baseball for over 30 years including the College World Series and a stint in the Major Leagues. Homolka also organizes umpire camps and does guest presentations on baseball, mathematics and umpiring.